

An ecology of invention: for relational, situated, and diverse practices in sound creation and research

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Abstract. The text departs from the field of the ecologies of music and sound to critique dualistic and decontextualized approaches to sound creation and investigation practices. The central objective is to advocate for paradigms for artistic practice and research that are based on the principles of relationality, situatedness, and diversity. The theoretical-methodological framework articulates concepts from sound ecology with those of the ‘ecology of mind’, ‘individuation’, and ‘technodiversity’, promoting a non-dichotomous reflection on the relationships between technology, nature, and culture. As a result, an ‘ecology of invention’ is proposed, in which technical, creative, and theoretical processes are configured from relational, situated, and diverse aspects, rejecting hegemonic and monolithic notions of nature, culture, and technology.

Keywords. Ecologies of sound and music, Technodiversity, Gregory Bateson, Gilbert Simondon, Yuk Hui.

Uma ecologia da invenção: por práticas relacionais, situadas e diversas na criação e investigação sonora.

Resumo. Este texto parte do campo das ecologias da música e do som para realizar uma crítica a abordagens dualistas e descontextualizadas das práticas de criação e investigação sonoras. O objetivo central é defender paradigmas para a prática e a pesquisa artística que sejam baseados nos princípios da relacionalidade, situacionalidade e diversidade. O referencial teórico-metodológico articula os conceitos da ecologia sonora com aqueles da ‘ecologia da mente’, ‘individuação’, e ‘tecnodiversidade’, promovendo uma reflexão não dicotômica sobre as relações entre tecnologia, natureza e cultura. Como resultado, propõe-se uma ‘ecologia da invenção’, em que processos técnicos, criativos e teóricos configurem-se a partir de aspectos relacionais, situados e diversos, rechaçando noções hegemônicas e monolíticas de natureza, cultura e tecnologia.

Palavras-chave. Ecologias do som e da música, Tecnodiversidade, Gregory Bateson, Gilbert Simondon, Yuk Hui.

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1. Introduction

As emerging perspectives, ecologies of music and sound re-evaluate sound and sound-related practices by examining how they weave humans, non-humans, contexts, environments, and technical objects into a *network of relationships* (SOLOMOS, 2023, p. 19–24; VARELA, 2025, p. 20)¹. Works related to these perspectives often analyze aesthetic and social experiences by challenging decontextualized, objectified, alienated, or reified conceptions of sound and sound practices (DI SCIPIO, 2015, p. 284; SOLOMOS, 2023, p. 30). These studies span from critiques and analyses of the use of sound in non-artistic contexts, such as commercial and interactive applications or even as a means of warfare, to the creation of new aesthetic experiences.

This involves moving discourses away from detailed structuralist analyses and reorienting them toward new axes of inquiry, which, as this paper will argue, are grounded in *diversity*, *situatedness*, and *relationality*. This reorientation was significantly influenced by recent aesthetic and creative experiences in sound art, electroacoustic music, and other artistic fields, with artists increasingly engaging in “new modes of creation and thought” (SOLOMOS, 2023, p. 7), driving what Makis Solomos, Roberto Barbanti, and others identify as an “ecological turn in art” (BARBANTI *et al.*, 2024, p. 5)².

This paper offers a theoretical and reflexive exploration of creative and investigative practices in sound and music ecologies, drawing on key contributions from *cybernetics* and the *philosophy of technology*—disciplines that, while still distant from this field, provide vital concepts for rethinking the relationships among technology, nature, and culture. In particular,

¹ The concept of *network of relationships* is used by Makis Solomos to approach sound and sound-related practices in a *relational* and non-objectified way (SOLOMOS, 2023, p. 19–24). In a broader context, dealing both with machine and living *autopoietic* systems, the biologist and philosopher Francisco Varela employs the concepts of *network of relations* and *network of processes* to refer to the relationships that structural components of closed, self-organizing systems establish with each other in order to enable their self-maintenance and self-organization (VARELA, 2025, p. 20). In the present paper, however, the term *network of relationships* is used in a broader sense, encompassing not only sound-related practices or closed, self-organizing systems, but also the diverse aspects of the multiple interactions that are intertwined between humans, other living beings, technical artifacts, and the environment.

² While a more methodical discussion of sound ecologies emerges from the works of these authors, it is important to note that, in the Brazilian context, the term *ecology of sound* had already been employed by Marisa Fonterrada in a music education book strongly influenced by Murray Schafer’s approach to *soundscapes* (FONTEERRADA, 2004; SCHAFFER, 1977).



it highlights the relevance of ideas from Gregory Bateson, Gilbert Simondon, and Yuk Hui. Their work, echoing that of influential authors such as Donna Haraway, Bruno Latour, Eduardo Viveiros de Castro, and Philippe Descola, offers a powerful critique of foundational dualisms like *nature/culture*, *technology/culture*, and *technology/nature*. By transcending these dualisms, their thought provides new insights for creative and theoretical practices in sound and music ecologies, leading us to propose an *ecology of invention* as a paradigm for creative and investigative work based on *relational*, *situated*, and *diverse* approaches towards technology, nature, and culture. While the paper does not delve into specific case studies or artistic examples due to space constraints, it aims to connect the sound ecologies field with these aforementioned theoretical contributions, possibly inspiring future research and creative works.

After reflecting on *relationality*, *situatedness*, and *diversity* as key aspects of ecologies of sound and music (section 2), and approaching the ideas of Bateson, Simondon, and Hui (sections 3, 4, 5, respectively), the paper concludes (section 6) with a synthesis of the discussed concepts, emphasizing their relevance for sound-related creative practices and research, proposing the idea of an *ecology of invention*.

2. Relationality, situatedness, and diversity

By proposing new theoretical frameworks and prompting a re-evaluation of theories and practices, perspectives on the ecology of sound have been influential in providing new ways of understanding the relationships between sound, its related practices, and the environment. These perspectives have become increasingly relevant within artistic research, particularly in fields such as sound art, electroacoustic music, and other creative practices.

A key aspect of these perspectives is their attempt to reframe sound and music practices, moving away from *autonomous*, *decontextualized*, and *universal* approaches to sound-related practices/discourses towards more *relational*, *situated*, and *diverse* perspectives. This movement, in its different forms, can be seen as an effort to bridge the gap between sound-related practices/discourses, on one hand, and the environmental, social, and political issues of increasing relevance in the contemporary world, on the other. In face of these issues, new perspectives imply a reconsideration of ethical and aesthetical values, moving away from the already outdated vanguardist and modernist emphasis on *autonomy*, *originality*, and



innovation—values that have been central to the history of art in the 20th century, especially in Europe and North America—towards more *relational*, *situated*, and *diverse* principles.

Relationality, here, refers to the interconnectedness of sounds and sound practices with broader social, cultural, and environmental issues. This means not only that sounds and sound-related practices are not isolated phenomena, but also that they are constituted by the very networks of relationships that include humans, technical artifacts, other living beings, contexts, and environments.

Situatedness refers to the acknowledgment of the specific temporal, spatial, cultural, political, and environmental *contexts* in which sound practices occur. This means, among other things, that, while reduced-listening, structuralist, and spectromorphological descriptive approaches to sound and sound-related practices have been important for the development of composition, analysis, sound studies, and sound arts, they are recognized to be not sufficient to understand the complexity of sound-related processes from an ecological perspective. This does not imply that the tools and methods provided by these approaches are no longer relevant in practical terms, but rather that they can be biased and limiting when applied in alienated and decontextualized ways.

Diversity refers to the plurality of perspectives, traditions, technologies, imaginations, practices, living beings, knowledges, agents, and contexts that play a role in the sound-related networks of relationships within the various contexts where sound practices occur. Certainly, these diverse perspectives are not those traditionally considered by hegemonic Eurocentric traditions, even at their most curious—or when clearly seduced by a baffling exoticism—regarding non-Western and non-hegemonic perspectives.

By establishing new paradigms to assess sound and sound-related practices, *relationality*, *situatedness*, and *diversity* are strategic to confront hegemonic dualisms that have been central to the development of Western thought and, therefore, are implicit in different sound-related theories and practices. Such dualisms are not only those that establish pairwise dichotomies between *nature*, *culture*, and *technology* but also those between *human/non-human/machine*, *subject/object*, and *individual/collective*, among others. Oppositions that, in a broader context, have been disputed by a wide range of perspectives, including feminist, posthumanist, perspectivist, and decolonial theories (CASTRO, EDUARDO VIVEIROS DE, 2006; DESCOLA, 2015; HARAWAY, 2006; KOHN, 2013; QUIJANO, 2024; WOLFE, 2003).



Often, these critiques reject reified and pragmatic views of technology and consider the anthropological, cultural, and environmental dimensions of technical artifacts and technical mediation (HUI, 2020, 2024; LATOUR, 1994). Furthermore, they go beyond a critique of the simplistic notion of technology as a universal, neutral force, to problematize the very boundaries that separate humans, other living beings, technical artifacts, and the environment. This problematization is allegorically illustrated by Gregory Bateson, who imagines himself as a blind man walking with a stick and questions the boundaries of his own perception and cognition regarding his body, the technical artifact (the stick), and the environment around him: “Where do I start? Is my mental system bounded at the handle of the stick? Is it bounded by my skin? Does it start halfway up the stick? Does it start at the tip of the stick?” (BATESON, 1987, p. 466).

3. Bateson and the *ecology of mind*

When considered in the context of a *network of relationships*—encompassing inequality, international conflicts, capitalist exploitation, etc—the environmental crisis of our time cannot be regarded as an isolated phenomenon. The global warming, the extinction of species, the pollution of air, water, and soil, the depletion of natural resources, and the destruction of ecosystems are entangled with a broader set of social, cultural, political, scientific, and economic issues. The causes and consequences of these issues intertwine and reinforce each other, radiating through various spheres of social, political, economic, and cultural life, blurring the lines between what is considered *natural* and *social*, *cultural* and *technical*, *political* and *scientific*.

This aspect, which in recent years has become evident with climate change and COVID-19 pandemic denialism and, currently, with the complexity of topics related to artificial intelligence, can be read as an increasingly intense and explicit manifestation of what Bruno Latour termed the *proliferation of hybrids* (LATOUR, 1993). The recognition of this *hybridization* is strategic for positioning the complexity of the network of relationships established among fundamental issues related to the environment, society, politics, economics, culture, and technology today. At the same time, it requires a critical-interpretive process of the epistemic and even ideological foundations that seem to culturally ground these issues.



It is remarkable, then, the proposal of an *ecosophy*, such as Félix Guattari's (2014), has as its epigraph the mention of the *ecology of bad ideas* that Gregory Bateson relates to a *pathology of epistemologies*:

Now we begin to see some of the epistemological fallacies of Occidental civilization. [...] Darwin proposed a theory of natural selection and evolution in which the unit of survival was either the family line or the species or subspecies or something of the sort. But today it is quite obvious that this is not the unit of survival in the real biological world. The unit of survival is *organism plus environment*. [...] If, now, we correct the Darwinian unit of survival to include the environment and the interaction between organism and environment, a very strange and surprising identity emerges: *the unit of evolutionary survival turns out to be identical with the unit of mind*. [...] Let us now consider what happens when you make the epistemological error of choosing the wrong unit: you end up with the species versus the other species around it or versus the environment in which it operates. Man against nature. You end up, in fact, with Kaneohe Bay polluted, Lake Erie a slimy green mess, and "Let's build bigger atom bombs to kill off the next-door neighbors." (BATESON, 1987, p. 489)³

Bateson's analysis can be readily applied to various contemporary issues, encompassing not only how humans relate to the environment and other living beings, but also how they engage in social, political, and technical relationships. Central to his critique is the understanding of social life as a zero-sum game, in which the individual's sole interaction with others and their environment is one of competition, exploitation, and domination. These epistemological errors, according to Bateson, are rooted in a *pathology of epistemologies* that leads to a narrow understanding of the world, where the individual is seen as the sole unit of survival, disconnected from the broader networks of relationships that define existence.

When you narrow down your epistemology and act on the premise "What interests me is me, or my organization, or my species," you chop off consideration of other loops of the loop structure. (...) You and I are so deeply acculturated to the idea of "self" and organization and species that it is hard to believe that man might view his relations with the environment in any other way than the way which I have rather unfairly

³ For Bateson, *mind* is immanent and not transcendent, and emerges from the cybernetic relationships between body, technical artifacts, and environment. It is, thus, not a "spiritual" property of the individual nor is it equivalent to the concept of "self", but the very network that immanently connects the individual to the environment and to other individuals, human or not, through engagements and technical mediation. (BATESON, 1987, p. 323)



blamed upon the nineteenth century evolutionists. (BATESON, 1987, p. 489–490)

4. Simondon and the *ecology of the technical objects*

If we consider Bateson's critique on these "ecology of bad ideas" in terms of ontologies and considering the network of relationships between humans, other living beings, technology, and environment, it is possible to approach his remarks to Gilbert Simondon's works about *individuation*, *technical objects* and *psychic/collective individuation* (SIMONDON, 1989, 2005, 2007). While *ecology* is not an explicit theme in Simondon's works, his conceptualization on *individuation* offer valuable insights to an ecological perspective on sound and sound-related practices.

In different works, Simondon begins by criticizing both substantialist and hylemorphic ontologies, which take the individual as granted. He presents the emergence of the individual and of the associated milieu (which we can relate, here, to a broader notion of *environment*) as a dynamic process in which both are continuously defined and redefined as an individual emerges from a meta-stable *pre-individual reality*, through the process of *transduction*.

This perspective resonates also in his reevaluation of *technology*. The idea that a technical artifact, such as a brick, could be understood as the hylemorphic sum of *material* (clay) and *form* (parallelepiped) is, according to Simondon, a perspective that not only ignores the dynamic processes of the technical imagination and craftsmanship—segregating, thus, *technology* from *culture*—but also embeds, borrowing Bateson's terms, an ecology of very *bad ideas*.

The technical operation that *imposes a form on a passive and undetermined matter* isn't just an operation considered abstractly by the spectator who sees what enters the workshop and what leaves it without knowing the elaboration properly speaking. This is essentially the operation controlled by the free man and executed by the slave; the free man chooses the matter—which is undetermined because it suffices to designate it generically by the name substance—without seeing it, without manipulating it, and without preparing it: the object will be made of wood or iron or clay. The veritable passivity of the matter is its abstract availability behind the given order that other men will execute. (...) It is also through social conditioning that the soul is opposed to the body; it is not through the body that the individual is a citizen, participates in collective judgments and shared beliefs, and lives on in the memory of his fellow citizens: the soul is distinguished



from the body just as the citizen is distinguished from the living human being. The distinction between matter and form, between the soul and the body, reflects a city that contains citizens in opposition to slaves. (SIMONDON, 2005, p. 51, 2020, p. 35–36)

The position emerging from this critique centers on a relational and non-alienated perspective on *technology*, its objects, and its artifacts. According to Simondon, alienation is not simply a matter of the *property* of the means of production but stems from an impoverished relationship between humans and technical objects, one in which a psychophysical and collective connection is lacking. In the capitalist production side, this alienation reduces humans to mere supervisors of machines. In the consumer side, it fosters a fetishistic relationship with technical artifacts, which acquire a near-totemic status as *gadgets*, not anymore seen and understood as *human constructions* that can be interpreted and reconfigured, but rather as closed and sealed systems that carry predetermined rituals of operation, pragmatism, usage, and hedonic enjoyment.

To invent is to make one's thought function as a machine might function, neither according to causality, which is too fragmentary, nor according to finality, which is too unitary, but according to the dynamism of lived functioning, grasped because it is produced, accompanied in its genesis. The machine is a being that functions. Its mechanisms concretize a coherent dynamism that once existed in thought, which were that thought. During invention, the dynamism of thought converted itself into functioning forms. Inversely, the machine, in functioning, is subject to or produces a certain number of variations around the fundamental rhythms of its functioning, arising from its definite forms. These variations are what are significant, and they are significant with respect to the archetype of functioning, which is that of thought in the process of invention. One has to have invented or reinvented the machine if the machine's variations of functioning are to become information. (SIMONDON, 1989, p. 191–192, 2017, p. 151)

Simondon's concept of *invention* and *reinvention* is appealing, as it allows us to think of technical objects and artifacts as cultural and aesthetic products such as books or paintings: human creations that can be read, interpreted, and reinterpreted. In their moving mechanisms and in the logic of their functioning, technical objects and artifacts mimesis, mechanically, the thoughts and gestures of their inventors. Inversely, *invention*, as a process involving the



structuring of thoughts, gestures, or observations into mobile and logical mechanisms, is not merely ingenious but also creative, aesthetic, and interpretative.

A good example of this is the variety of zoomorphic automata invented across different places and periods, imitating the movements, sounds, and even metabolic processes of certain animals (KANG, 2011). As inventions and technical artifacts, these mechanisms are hardly approached by pragmatic, abstract, and positivist notions of technology: heideggerian concepts like *Zuhandenheit*, *Vorhandenheit*, and *Gestell* reveal their conceptual infertility here. As technoaesthetical mechanisms, automata demonstrate that the creative and inventive process, through this mimetic act of inventing a *second nature*—conceived here not as human behavior and habits, but as the very mimesis of non-humans through technical inventions—, reveals not only the striking and often unperceived aspects of animal movements or sounds, but diverse and inventive ways of conceptualizing, interpreting, and listening to them.

5. Hui and the *ecology of machines*

Strongly influenced by Simondon's works, the philosopher Yuk Hui challenges the hegemonic conception of technology, arguing that, as a philosophical concept tied to human activities of making and practice, it cannot be assumed to be universal.

There is a general misconception that all technics are equal, that all skills and artificial products coming from all cultures can be reduced to one thing called 'technology'. And indeed, it is almost impossible to deny that technics can be understood as the extension of the body or the exteriorization of memory. Yet they may not be *perceived* or reflected upon in the same way in different cultures. (HUI, 2022, p. 9)

Through the concept of *cosmotechnics*, Hui criticizes the *homogenization* of technology, linking this to Western perspectives that rely on dualisms such as *nature/culture*, *nature/technology*, and *technology/culture*.

Let me give you a preliminary definition of cosmotechnics: it is the unification of the cosmos and the moral through technical activities, whether craft-making or art-making. (HUI, 2017, p. 6).



While Simondon challenged the *culture/technology* dualism—and the broader epistemological and ethical problems that this dualism implies— and anthropologists like Eduardo Viveiros de Castro and Philippe Descola addressed the *nature/culture* dualism by proposing the provocative notion of *multinaturalism*, Yuk Hui confronts the *nature/technology* dualism and the *homogenization* of technology that it implies (CASTRO, 2006; HUI, 2020; SIMONDON, 1989; STIEGLER, 2020):

I would like to propose to reflect on an ecology of machines. To open this ecology of machines, we will need first of all to go back to the concept of ecology. The fundament of ecology is diversities, since it is only with biodiversities (or multispecies including all forms of organisms including bacterial) that the ecological system can be conceptualized. To discuss the ecology of machines, we will need a different notion in parallel to *biodiversity*, which we call *technodiversity* (HUI, 2020, p. 63).

As Timnit Gebru and Émile Torres—who diagnose a new form of conservative ideology traceable to the British Eugenics Society between the lines of hegemonic discourses on “General Artificial Intelligence” and “Technological Singularity” (GEBRU; TORRES, 2024)—Hui identifies a sectarian eschatology linked to the culture around the development of AI technologies in so-called *Big Tech* companies. Against these discourses, Hui calls for an adequate “culture of the prosthesis” where technology enhances human capabilities instead of competing with them (HUI, 2023). This requires moving past anthropomorphic views of machines and fatalistic historical narratives in order to ethically experiment with our technological future. Like Simondon, Hui also denounces the *technology/culture* dichotomy, which contributes to the *homogenization* of technology and, we could also argue in Gramscian terms, to the *hegemonization* of a Eurocentric perspective on culture and technology: a colonialist view of the world that endangers, at once, the diversity of life-forms, of knowledges/imaginings, and of technical practices/inventions.

...what Vandana Shiva called the “monoculture of the mind” is omnipresent in the capitalist logic of globalization; we, therefore, end up having monotecnology, which recklessly views itself as the only option.



The “monoculture of the mind”, which endangers both biodiversity and noodiversity, suggests that the key to resolving this problem is to return to the discourse of technodiversity. Therefore, the matrix of biodiversity, noodiversity, and technodiversity form a more comprehensive framework than the dialectics between nature and technology for understanding the planetary condition. (...) ...without differentiation and diversification, it is impossible to talk about difference and diversity. Diversity is not only to be maintained, but it also has to be *constantly created*. (HUI, 2024, p. 225–226)

6. Final remarks: towards an *ecology of invention*

Yes, Europe is a garden. We have built a garden. Everything works. It is the best combination of political freedom, economic prosperity and social cohesion that the humankind has been able to build—the three things together. (...) The rest of the world—and you know this very well, Federica—is not exactly a garden. Most of the rest of the world is a jungle, and the jungle could invade the garden. (BORRELL, 2022)

Those dualisms are dubious not because all such conceptual dichotomies are in principle pernicious but because these in particular require, if they are to unify (any) two worlds, discriminating between their respective inhabitants. Every Great Divider is a mononaturalist. (CASTRO, 2014, p. 63)

The ignoble euphemism by the then-High Representative of the European Union, Josep Borrell, built on the colonialist dualism portraying Europe as a garden and the rest of the world as a jungle, highlights the problematic epistemologies underpinning the hegemonic discourses of *monotechnology*, *monoculture*, and *mononature*. Europe is clearly not a garden in 2025, nor was it ever before. Yet, these same epistemological “gardens” depicted by Mr. Borrell legitimize not only symbolic and ideological borders, but also concrete life-threatening walls, fences, and military actions segregating or simply eliminating thousands of people who dare to cross or defy them, whether between Africa and Europe, between Latin America and the United States, between Gaza and Israel, or—in the Brazilian context—between the favelas and other kind of “peripheral” territories and the wealthy neighborhoods and gated communities.

While the ecologies of sound and music have opened new perspectives for research and sonic creation, it is crucial to recognize that they are not immune to the risks and biases of



hegemonic dualist epistemologies. Precisely because they are hegemonic, establishing not merely conceptual dualisms but also symbolic and real borders, these epistemologies contaminate diverse fields of knowledge and life with their biases. In ethical, methodological, and political terms, recognizing these biases requires, on the one hand, an awareness of the *ecology of bad ideas* that implicitly or explicitly reinforces them. This includes being suspicious of discourses and practices that uncritically reproduce the aforementioned dualisms, as well as those that propose alternatives derived almost exclusively from hegemonic Eurocentric traditions. On the other hand, it requires us to actively seek alternative practices and perspectives and to foster an *ecology of invention* or an *ecology of imagination*: to promote in our artistic, research, and educational practices for *relational*, *situated*, and *diverse* approaches to sound, music, technology, nature, and culture.

In its *relational* aspect, such an *ecology of invention* moves beyond positivist views of progress and obsolescence to focus on the *network of relationships* between humans, non-humans, technical artifacts, and the environment. In its *situated* aspect, it grounds sound practices in their specific cultural, geographical, and political contexts, resisting the imposition of decontextualized hegemonic narratives. In its *diverse* aspect, it fosters a plurality of perspectives, knowledges, imaginations, and technologies, not only through engagement with the world but by actively creating new interfaces, instruments, and machines for listening and being listened to.

For practical constraints, this essay does not delve into specific case studies or artistic examples. In future works, we intend to explore how these concepts have been applied in different artistic, research, and educational practices.

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